LICHENS OF LITTLE BARRIER ISLAND (HAUTURU), NORTHERN NEW ZEALAND

BRUCE W. HAYWARD*, ANTHONY E. WRIGHT*, AND GLENYS C. HAYWARD**

*AUCKLAND INSTITUTE AND MUSEUM

**AUCKLAND

Abstract. Two hundred and fifty-one lichen species from 96 genera are recorded from Little Barrier Island, northern New Zealand. This represents about 20% of the present total of known lichens in the New Zealand flora and this richness reflects the diversity of largely unmodified natural vegetation types and habitats on the island. These Little Barrier records include the second New Zealand records of *Arthonia tumidula, Calicium robustellum, Dimerella zonata, Hypotrachyna immaculata* and *Lopadium monosporum* (endemic); and the most northerly records in New Zealand of a further 20 species.

In tandem with the vascular vegetation, the lichen flora shows a rough zonation with increasing altitude. *Verrucaria maura* and *Lichina confinis* are restricted to intertidal rocks. The flora of maritime rocks just above high tide is dominated by *Buellia, Lecidea, Pertusaria, Rimelia, Parmotrema, Heterodermia, Xanthoparmelia, Neofuscelia, Pannaria elatior* and *Ramalina.*

Coastal scrub has a characteristic association of yellow *Xanthoria* and *Caloplaca*, grey *Physcia caesia* and crustose *Opegrapha intertexta.* Coastal pohutukawa forest lichens are dominated by *Hypotrachyna, Parmelinopsis, Parmotrema, Rimelia* and *Usnea inermis.*

Kanuka and kanuka-mixed forest below about 300 m have rich lichen floras dominated by many *Pseudocyphellaria* (especially *P. carpoloma, P. montagnei* and *P. coriacea*), *Psoroma, Sticta latifrons, Coccocarpia, Heterodermia* and *Pannaria.* Ground dwelling lichens beneath the kanuka forest are mainly *Cladina confusa, Cladia aggregata, Stereocaulon ramulosum*, and many *Cladonia.*

Kauri and mixed forest types between 200 and 500 m have epiphytic floras dominated by *Pseudocyphellaria glabra, P. multifida, Psoroma, Heterodermia, Menegazzia, Megalospora* and *Megalaria grossa*, with *Metus conglomeratus* and *Pseudocyphellaria dissimilis* common on the forest floor.

Lichens in the high humidity mixed forest and scrub above 500 m are dominated by *Sticta filix* with subdominant *Pseudocyphellaria multifida, P. faveolata, P. glabra, P. coronata, Sphaerophorus melanocarpus* and *Cladia aggregata. Sphaerophorus tener, Siphula decumbens* and *Phaeographis exaltata* are abundant above about 650 m.

Rec. Auckland Inst. Mus. 28: 185-199 20 December 1991

The lichens recorded here were collected and studied by the authors during a 7 day visit to Little Barrier Island by the Offshore Islands Research Group in May 1990 and by BWH during an 8 day visit by the Auckland University Field Club in August 1981.

Little Barrier Island (latitude 36°12′S, longitude 175°07′E) is a large Nature Reserve (2 817 hectares) lying at the entrance to the Hauraki Gulf, midway between Great Barrier Island and Northland (Fig. 1), and 80 km north of Auckland. The island is a partly eroded, Pleistocene, andesite stratovolcano (Kear 1961). Its coastline has

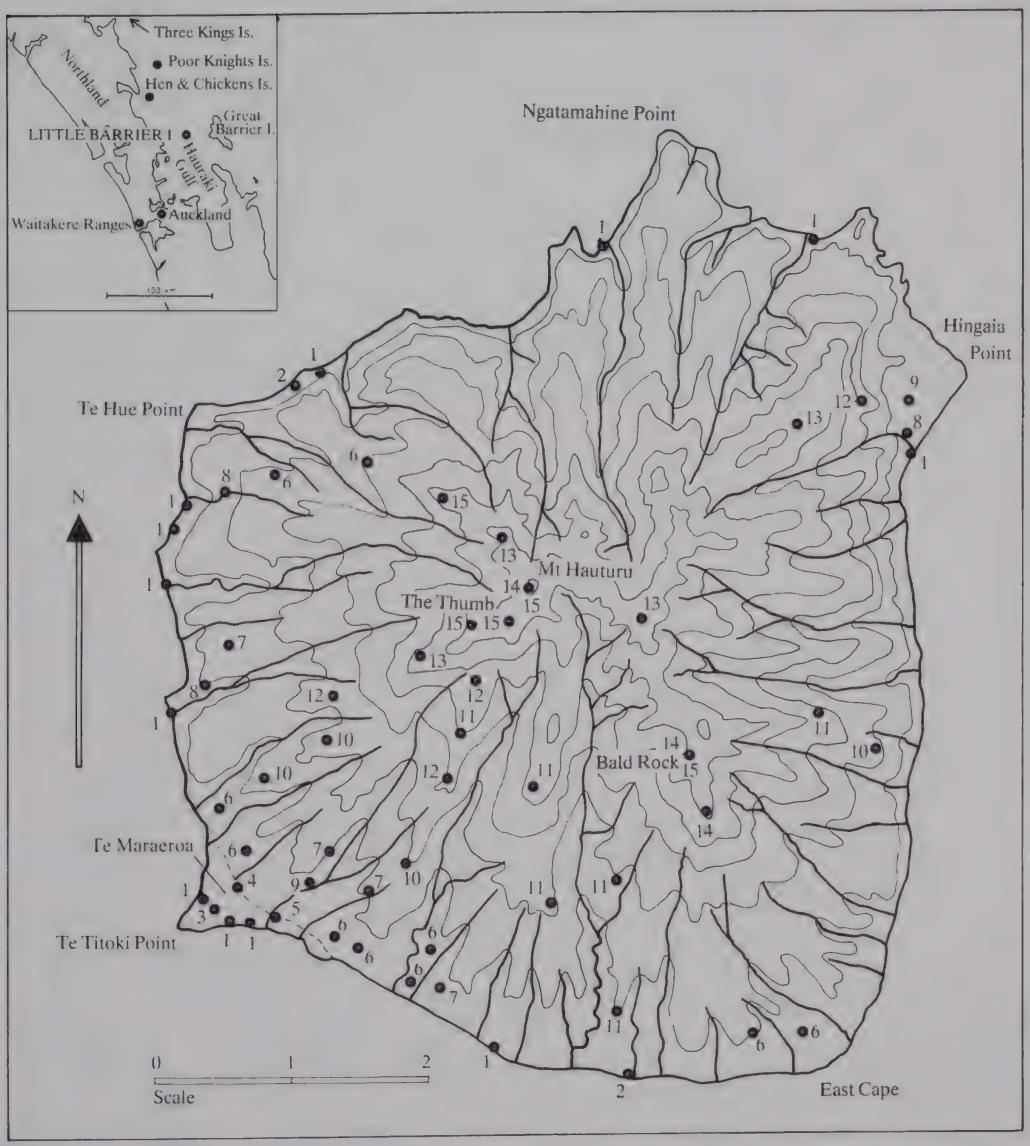

Fig. 1. Main localities where lichens were collected on Little Barrier Island. Numbers refer to habitat codes in species list.

eroded back in the soft laharic breccias to form sheer cliffs, up to 300 m high. Its lower ridges (below 300 m) preserve the original gentle slopes of the laharic ring plain cut by a radial pattern of deeply incised streams. The original central cone has been extensively eroded and now consists of a group of steep central peaks, the highest of which (Hauturu) is 722 m above sea level. The low-lying, flat land forming Te Maraeroa on the southwest corner is formed by the convergence of two boulder banks, created by opposing wave systems.

Rainfall is spread throughout the year with an annual mean of 1550 mm at sea level and considerably greater at higher altitudes. The mean number of days per year having at least 0.1 mm of rain is close to 200. Hence Little Barrier has a rich lichen flora.

Little Barrier has one of the largest forested areas in New Zealand that has not been modified by mammalian herbivores. The steep, central, higher parts of the island are clothed in near virgin forest, ranging from patches of subalpine scrub on the peaks to mixtures of southern rata (*Metrosideros umbellata*), tawaroa (*Beilschmiedia tawaroa*), hard beech (*Nothofagus truncata*) and kauri (*Agathis australis*) on the slopes. Much of the lower slopes (below 300 m) was cleared or burnt in prehistoric and early European times (Hayward 1982) and is presently covered in regenerating kanuka (*Kunzea ericoides*) and kanuka-mixed forest. Mature mixed broadleaf forest still occupies most of the incised stream valleys and ravines all the way to the coast. Te Maraeroa flat is currently grazed grassland with scattered clumps of mature kanuka, a small orchard and groves of coastal pohutukawa (*Metrosideros excelsa*).

There has been no previous work on the lichens of Little Barrier Island, apart from a few isolated specimens collected over the years by botanists studying the higher plants. The vegetation of the island and its altitudinal zonation has been described by Hamilton and Atkinson (1961). In this study, representative lichen collections and observations were made in all the main habitats. Every endeavour was also made to obtain a full lichen species list for the island.

SPECIES LIST

The right hand column refers to voucher specimens of those lichens which are lodged in the herbaria of the Auckland Institute and Museum (AK), or the National Museum, Wellington (WELT).

Habitats (Fig. 1)

1 marine and maritime
2 coastal scrub
3 coastal pohutukawa
4 grassland (below 20 m)
5 orchard trees
6 mature kanuka forest
7 kanuka-mixed forest
8 open stream beds
9 mixed broadleaf forest (below 250 m)
10 kauri forest
11 kauri-beech forest
12 mixed forest (250-500 m)
13 mixed forest (above 500 m)
14 open rocky bluffs (above 500 m)
15 subalpine scrub

Substrates

b = bark
ch = charcoal
d = decaying logs
l = leaf
m = moss
p = fern
r = rock
s = soil

Arthonia tumidula (Ach.) Ach.	b5	AK203196
Arthonia sp.	b3	AK203197
Arthothelium fusconigrum (Nyl.) Mull. Arg.	b11	AK203277
Bacidia albidoplumbea (J. D. Hook. & Taylor) Hellbom	b4,b7,b15	AK203166
Bacidia buchananii (Stirton) Hellbom	m7,m8,mr9	AK193398
Bacidia aff. *subcerina* Zahlbr.	r1	
Baeomyces absolutus Tuck.	s7	AK174619
Baeomyces arcuatus Stirton	s6	
Baeomyces heteromorphus Nyl. ex Church. Bab. & Mitten	ds6,r15	AK193406
Brigantiaea chrysosticta (J. D. Hook. & Taylor) Hafellner & Bellemere	b7,b12	AK203278
Brigantiaea tabacodes (Zahlbr.) Hafellner	b6,m7,m9,b10,b11,b12,m13	AK193428
Buellia nitrophila Zahlbr.	r1	AK203165
Buellia punctata (Hoffm.) Massal.	b3,b11,r15	
Buellia stellulata (Taylor) Mudd	r1	AK203201
Byssoloma subdiscordans (Nyl.) P. James	p12	AK203164
Calicium hyperelloides Nyl.	d1	AK193448
Calicium robustellatum Nyl.	d1	
Calicium tricolor F. Wilson	d1	AK203333
Caloplaca holocarpa (Hoffm.) Wade	r1	
Caloplaca inclinans (Stirton) Hellbom	b2	AK193562
Caloplaca litoralis Zahlbr.	r1	AK203163
Candelariella vitellina (Ach.) Mull. Arg.	r1	
Catapyrenium cinereum (Pers.) Korber	r1	AK193372
Catillaria kelica (Stirton) Zahlbr.	b11	AK161806
Chrysothrix candelaris (L.) Laundon	b3	AK193494
Cladia aggregata (Sw.) Nyl.	s6,ms15	AK162149
Cladia retipora (Labill.) Nyl.	s6,s14	AK193537
Cladia sullivanii (Mull. Arg.) W. Martin	r14	AK193533
Cladina confusa (R. Sant.) Follmann & Ahti	s6,s15	AK160408
Cladonia bacillaris Nyl.	d4	
Cladonia capitellata (J. D. Hook. & Taylor) Church. Bab.	s6,s14,s15	AK154458
Cladonia cervicornis subsp. *verticillata* (Hoffm.) Ahti	s1	AK174609
Cladonia chlorophaea (Floerke ex Sommerf.) Sprengel	s6,s15	AK174610
Cladonia corniculata Ahti & Kashiwadani	s11	AK203162
Cladonia cornuta (L.) Hoffm.	s15	AK203161
Cladonia crispata (Ach.) Flotow	s15	AK203160
Cladonia enantia Nyl.	s6	
Cladonia fimbriata (L.) Fr.	s1,s6,s14,s15	AK174613
Cladonia floerkeana (Fr.) Floerke	ds1,r4,s6,s14	AK174560
Cladonia furcata (Huds.) Schrader	s6	AK203159
Cladonia gracilis subsp. *tenerrima* Ahti	s6	
Cladonia ochrochlora Floerke	d1,ds6	AK174564
Cladonia polycarpoides Nyl. ex Gasilien	s6	
Cladonia praetermissa A. W. Archer	s11,s12,s13	AK203158
Cladonia pyxidata (L.) Hoffm.	d1	AK193452
Cladonia ramulosa (With.) Laundon	s1,b11,s15	AK174607
Cladonia scabriuscula (Delise) Leighton	s13,bs15	AK154751
Cladonia squamosa (Scop.) Hoffm.	b1	
Cladonia squamosula Mull. Arg.	d1,s11	AK203177
Cladonia sulcata A. W. Archer	s1	AK203176
Clathroporina exocha (Nyl.) Mull. Arg.	r1,b2,r7,b9	AK174570
Coccocarpia erythroxyli (Sprengel) Swinsc. & Krog	b6,b11,b15	AK154634

Coccocarpia palmicola (Sprengel) Arvidsson & D. Galloway	b3,b6,b11	AK193485
Coccocarpia pellita (Ach.) Mull. Arg. emend. R. Sant.	b4,b6	AK174580
Coccotrema cucurbitula (Mont.) Mull. Arg.	b13,b15	AK203175
Coenogonium implexum Nyl.	b3,b4	AK174584
Collema fasciculare (L.) Wiggers	b6,b10	AK193555
Collema laeve J. D. Hook. & Taylor	b4,b5,b6	AK160382
Collema subconveniens Nyl.	r1,r8	AK193378
Collema subflaccidum Degelius	b4,b5,b10	AK174591
Dendriscocaulon dendriothamnodes Dughi in D. Galloway	l13	
Dimerella lutea (Dickson) Trevisan	b6,l13	AK175109
Dimerella zonata (Mull. Arg.) R. Sant.	p15	AK203174
Diploicia canescens (Dickson) Massal.	r1,r3	AK193361
Dirinaria picta (Sw.) Clem. & Shear	b3	AK193581
Enterographa bella R. Sant.	l12	
Erioderma sorediatum D. Galloway & P. M. Jorg.	b6,b11	AK193554
Flavoparmelia soredians (Nyl.) Hale	r3,b5,b6	AK193447
Graphina monospora (Knight) Mull. Arg.	b6	
Graphina novae-zelandiae (Knight) G. Hayward	r1	AK193360
Graphis librata Knight	b11,b12	AK169706
Heterodermia isidiophora (Nyl.) Awasthi	r8	AK193569
Heterodermia japonica (Sato) Swinsc. & Krog	r1,br3,b6,b7,r8,b11,b13	AK193364
Heterodermia leucomelos subsp. *boryi* (Fee) Swinsc. & Krog	b11,b12,r15	AK193499
Heterodermia microphylla (Kurok.) Swinsc. & Krog	r1,r2,b6,b7,b11	AK193513
Heterodermia obscurata (Nyl.) Trevisan	rs1,r2,bs6,r12	AK193497
Heterodermia speciosa (Wulfen) Trevisan	r1,r9	AK193379
Hypogymnia subphysodes (Krempelh.) Filson	b15,r14	AK175176
Hypotrachyna immaculata (Kurokawa) Hale	b3	AK176076
Hypotrachyna osseoalba (Vain.) Park & Hale	b3,r14	AK172389
Hypotrachyna revoluta (Floerke) Hale	n4	AK203198
Laurera elatior (Stirton) D. Galloway	b6,b7,b11	AK193551
Lecanactis redingeri Zahlbr.	b4	WELT L3218
Lecanora campestris (Schaerer) Hue	r1	AK203194
Lecanora chlarotera Nyl.	b3	AK193385
Lecanora symmicta (Ach.) Ach.	b3	
Lecidea cerinocarpa Knight	b4	AK193451
Lecidea conisalea Knight	b6	AK203173
Lecidea laeta Stirton	b2	AK193564
Lecidea gallinarum Zahlbr.	r1	AK203172
Lecidea cf. *subcoarctata* Knight	r1	
Lecidea spp.	r1,r14	AK154407 AK157386
Leioderma duplicatum (Mull. Arg.) D. Galloway & P. M. Jorg.	b6,b11	
Leioderma sorediatum D. Galloway & P. M. Jorg.	b15	AK203279
Lepraria incana (L.) Ach.	rs1,b3,b12	AK193370
Leptogium azureum (Sw.) Mont.	b2,b4	
Leptogium coralloideum (Mey. & Flot.) Vainio	b4,b5,b10,b12	AK175192
Leptogium crispatellum Nyl.	b4,b6,l15	AK175195
Leptogium cyanescens (Rabenh.) Korber	r1,b4,b5,b6,r7,b11,b12	AK175201
Lichina confinis (O. F. Muller) Agardh	r1	
Lopadium monosporum (Knight) Hellbom	b6	AK193443
Megalaria grossa (Pers. ex. Nyl.) Hafellner	b3,b4,b6,b7,b11,b12,b15	AK203170

Megaloblastenia flavidoatra (Nyl.) Sipman	b3,b6,b11	AK193489
Megaloblastenia margiiniflexa (J. D. Hook. & Tayl.) Sipman	b3	AK203169
Megalospora bartlettii Sipman	b12	AK193530
Megalospora campylospora (Stirton) Sipman	b12	
Megalospora gompholoma (Mull. Arg.) Sipman	b6,bm11,b12	AK193559
Megalospora knightii Sipman	br7,r9,b10,b12,b13	AK193516
Melaspilea subeffigurans (Nyl.) Mull. Arg.	b5	AK175218
Menegazzia aucklandica (Zahlbr.) P. James & D. Galloway	b10	AK203280
Menegazzia circumsorediata R. Sant.	b7,b10,b11,b15	AK193539
Menegazzia eperforata P. James & D. Galloway	b10	AK193558
Menegazzia nothofagi (Zahlbr.) P. James & D. Galloway	b11,b12,l13,r14,b15	AK175221
Metus conglomeratus (F. Wilson) D. Galloway & P. James	s10,s11,ms13	AK193436
Miltidea ceroplasta (Church. Bab.) D. Galloway & Hafellner	b11,b12,b15	AK176038
Neofuscelia pulla (Ach.) Esslinger	r1	AK161859
Neofuscelia verrucella (Esslinger)Esslinger	r1	AK203205
Neophyllis melacarpa (F. Wilson) F. Wilson	b3,b11	AK162157
Nephroma plumbeum (Mont.) Mont.	bm15	AK193428
Ochrolechia parella (L.) Massal.	r1	AK203168
Opegrapha agelaeoides Nyl.	b3,b5,b6	AK193491
Opegrapha devia (Knight & Mitten) Nyl.	b6	
Opegrapha diaphoriza Nyl.	r1	AK169701
Opegrapha intertexta Knight	b2,b3,b4,b6,b8,b11	AK193501
Pannaria crenulata P. M. Jorg.	r9,b13,b12	AK193540
Pannaria elatior Stirton in Bailey	r1,b3,b4,bs6,r8	AK193380
Pannaria fulvescens (Mont.) Nyl.	bs6,b7,m12,b13	AK161265
Pannaria gemmascens Nyl.	b6	
Pannaria immixta Nyl.	b5,b6,b11,b15	AK193486
Pannaria subimmixta Knight	r3,s6,r7	AK193389
Parmelia erumpens Kurok.	dr1,b3,b6	AK172452
Parmelia saxatilis (L.) Ach.	r1	AK203167
Parmelia sulcata Taylor	r1	AK193369
Parmelia testacea Stirton	b4,b6,b11,b12	AK193561
Parmeliella nigrocincta (Mont.) Mull. Arg.	d9,b12	AK203204
Parmelinopsis jamesii (Hale) Elix & Hale	d1,b3	AK193579
Parmelinopsis cf. *jamesii* (Hale) Elix & Hale	b3	
Parmelinopsis spumosa (Asahina) Elix & Hale	b3,b4	AK175309
Parmelinopsis subfatiscens (Kurok.) Elix & Hale	b6	
Parmotrema arnoldii (Du Rietz) Hale	r1,r14,b15	AK193538
Parmotrema chinense (Osbeck) Hale & Ahti	br1,b3,b11,r14	AK175334
Parmotrema crinitum (Ach.) M. Choisy	b1,br3,br4,b6	AK162161
Parmotrema mellissii (Dodge) Hale	r8,r14	AK162160
Parmotrema subtinctorum (Zahlbr.) Hale	r1	AK193512
Parmotrema tinctorum (Nyl.) Hale	r1,br3	AK175358
Peltigera dolichorhiza (Nyl.) Nyl	s6,s15	AK162151
Peltigera nana Vainio	s15	AK193427
Peltigera ulcerata Mull. Arg.	s13	AK193541
Pertusaria aff. *amaurospora* Hellbom	r1	AK202460
Pertusaria dactylina (Ach.) Nyl.	s14	AK203191
Pertusaria lavata Mull. Arg.	r1,r8	AK175366
Pertusaria sorodes Stirton	b3	AK193510
Pertusaria aff. *theochroa* Krempelh.	r1	AK203193

Phaeographis australiensis Mull. Arg.	b5,b12	AK169704
Phaeographis exaltata (Mont. & v. d. Bosch) Mull. Arg.	b15	AK175376
Phaeographis inusta (Ach.) Mull. Arg.	b12	AK203190
Phyllopsora microdactyla (Knight) D. Galloway	b2,b6	AK203189
Physcia caesia (Hoffm.) Furnr.	r1,b2,b5	AK193502
Physcia tribacioides Nyl.	r1,r3,b6	AK193504
Physconia enteroxantha (Nyl.) Poelt	b3	AK193580
Placopsis parellina f. *argillacea* (Knight) Lamb	s1	AK202679
Poeltiaria turgescens (Korber) Hertel	r1	AK203188
Polychidium contortum Henssen	b6,b13,b15	AK193434
Porpidia albocaerulescens (Wulfen) Hertel & Knoph	r1,r14	AK203187
Porpidia sp.	r1	AK203203
Pseudocyphellaria aurata (Ach.) Vainio	r1,b4,b9	AK160637
Pseudocyphellaria carpoloma (Delise) Vainio	b6	AK162139
Pseudocyphellaria chloroleuca (J. D. Hook. & Taylor) Du Rietz	b12	AK161579
Pseudocyphellaria cinnamomea (A. Rich.) Vainio	r7,r9,r12,r13	AK193459
Pseudocyphellaria coriacea (J. D. Hook. & Taylor) D. Galloway & P. James	r1,b6,b12	AK162146
Pseudocyphellaria coronata (Mull. Arg.) Malme	b3,b6,b12,b13,b15	AK193401
Pseudocyphellaria crocata (L.) Vainio	r1,bs6	AK161503
Pseudocyphellaria dissimilis (Nyl.) D. Galloway & P. James	s6,s7,r9,b10,b12	AK154882
Pseudocyphellaria episticta (Nyl.) Vainio	b4,b6	AK161535
Pseudocyphellaria faveolata (Delise) Malme	b11,b13,bl15	AK181647
Pseudocyphellaria fimbriatoides D. Galloway & P. James	r8,r9	AK203281
Pseudocyphellaria glabra (J. D. Hook. & Taylor) Dodge	b10,b12,b13,b15	AK162145
Pseudocyphellaria granulata (Church. Bab.) Malme	b4	
Pseudocyphellaria haywardiorum D. Galloway	b4	AK203186
Pseudocyphellaria intricata (Delise) Vainio	bd6,b15	AK203283
Pseudocyphellaria knightii D. Galloway	r1	
Pseudocyphellaria lividofusca (Krempelh.) D. Galloway & P. James	b7,b12,b13,b15	AK193442
Pseudocyphellaria montagnei (Church. Bab.) D. Galloway & P. James	b6	AK162140
Pseudocyphellaria multifida (Nyl.) D. Galloway & P. James	b6,b9,b10,b11,b12,b13,b15	AK193431
Pseudocyphellaria pickeringii (Tuck.) D. Galloway	r1,b3,b4,b6,bd7	AK160259
Pseudocyphellaria poculifera (Mull. Arg.)D. Galloway & P. James	b3	AK203284
Pseudocyphellaria rubella (J. D. Hook. & Taylor) D. Galloway & P. James	b15	AK193420
Pseudocyphellaria rufovirescens (Church. Bab.) D. Galloway	b7,b13	AK193462
Pseudocyphellaria wilkinsii D. Galloway	b7	AK203285
Psoroma allorhizum (Nyl.) Hue	r1,b3,b6,b11,b12,bl13	AK193488
Psoroma araneosum (Church. Bab.) Nyl.	b6,d8	AK203286
Psoroma asperellum Nyl.	b11	
Psoroma athroophyllum Stirton	b6,b7,b11	AK203287
Psoroma implexum Stirton	b6,b7,b11,b12	AK193479
Psoroma leprolomum (Nyl.) Rasanen	b11,b15	AK203288
Psoroma microphyllizans (Nyl.) D. Galloway	r1,b6,l13	AK193442
Psoroma sphinctrinum (Mont.) Nyl.	b10,b12	AK193519
Psoroma xanthomelanum Nyl.	b15	AK193426
Psoromidium aleuroides (Stirton) D. Galloway	b11,b13,b15	AK202686

Punctelia borreri (Sm.) Krog	b5	AK176087
Pyrenula deliquescens (Knight) Mull. Arg.	b6,b7,b11	AK203184
Ramalina australiensis Nyl.	r1,r3	AK173649
Ramalina celastri (Sprengel) Krog & Swinscow	r1,r3,r4	AK102098
Ramonia sp.	b6	AK162195
Rhizocarpon geographicum (L.) DC	r1	
Rimelia cetrata (Ach.) Hale & Fletcher	r1,b3,s9,r14	AK171695
Rimelia reticulata (Taylor) Hale & Fletcher	r1,b3,b6,b11,r14	AK160196
Rinodina tubulata (Knight) Zahlbr.	r1	AK203183
Roccellinastrum neglectum Henssen & Vobis	b12,b13	AK193403
Schismatomma sp.	b7	AK193532
Siphula decumbens Nyl.	bs13,s15	AK193547
Siphula ramalinoides Nyl. ex Crombie	r14	AK173633
Sphaerophorus insignis Laurer	b6,b12	AK203289
Sphaerophorus melanocarpus (Sw.) DC.	b13,m15	AK193417
Sphaerophorus patagonicus (Dodge) Ohlsson	b12,b13,b15	AK173639
Sphaerophorus tener Laurer	b13,bm15	AK203290
Stereocaulon ramulosum Rauschel	r1,s6,r14,rs15	AK160561
Stereocaulon vesuvianum Pers.	r14	AK173604
Sticta cinereoglauca J. D. Hook. & Taylor	b7	
Sticta filix (Sw.) Nyl.	b12,b13,l15	AK161400
Sticta fuliginosa (Hoffm.) Ach.	b4,b5,r15	AK160396
Sticta lacera (J. D. Hook. & Taylor) Mull. Arg.	b12,b13	AK193402
Sticta latifrons A. Rich.	b3,b6,b7,b10	AK154810
Sticta squamata D. Galloway	r1,b3,b4,b6	AK154765
Sticta subcaperata (Nyl.) Nyl.	b3,b4,bs6,b7,b12,b13	AK162141
Strigula elegans (Fee) Mull. Arg.	l7	AK173618
Teloschistes chrysophthalmus (L.) Th. Fr.	b2	AK203291
Teloschistes flavicans (Sw.) Norman	b12	AK173622
Teloschistes xanthorioides J. Murray	b5	AK193576
Tephromela atra (Huds.) Hafellner in Kalb	r1,b5	AK175183
Thelotrema lepadinum (Ach.) Ach.	b3,b5,b6,r8	AK173624
Thysanothecium scutellatum (Fr.) D. Galloway	ch1	AK193449
Trapelia coarctata (Turner) M. Choisy	r6, r9,r11	AK193392
Trapeliopsis congregans (Zahlbr.) Brako	b2	
Trapeliopsis granulosa (Hoffm.) Lumbsch	r12	AK203182
Usnea arida Mot.	b5,b12,b15	
Usnea inermis Mot.	b3,b5,b6,b13	AK173594
Usnea molliuscula Stirton	b3,b5,b11	AK193578
Usnea rubicunda Stirton	r14,b15	AK203178
Verrucaria maura Wahlenb. ex Ach.	r1	
Xanthoparmelia australasica D. Galloway	r1	AK173597
Xanthoparmelia flavescentireagens (Gyelnik) D. Galloway	r1	AK203199
Xanthoparmelia furcata (Mull. Arg.) Hale	r1	AK173598
Xanthoparmelia mexicana (Gyelnik) Hale	r1	AK193635
Xanthoparmelia mougeotina (Nyl.) D. Galloway	r15	AK203177
Xanthoparmelia neotinctina (Elix) Elix & J. Johnston	r3	AK203200
Xanthoparmelia scabrosa (Taylor) Hale	r1,r3,b5	AK173599
Xanthoparmelia thamnoides (Kurok.) Hale	r1	AK203202
Xanthoria elegans (Link) Th. Fr.	r1	AK173600
Xanthoria ligulata (Korber) P. James	r1	AK193563
Xanthoria parietina (L.) Th. Fr.	r1,b2	AK203292

FLORISTICS

New and significant records

These Little Barrier records are the second New Zealand records of five species: *Arthonia tumidula, Calicium robustellum, Dimerella zonata, Hypotrachyna immaculata* and *Lopadium monosporum* (endemic); and the third New Zealand records of: *Caloplaca litoralis* (endemic), *Heterodermia isidiophora* and *Megalospora bartlettii* (endemic). This record of *Xanthoparmelia mougeotina* is the first from the North Island and in addition the list includes the most northerly records in New Zealand of a further 20 species: *Arthonia tumidula, Byssoloma subdiscordans, Buellia nitrophylla, Calicium tricolor, Caloplaca litoralis, Cladia sullivanii, Cladonia crispata, Hypotrachyna immaculata, Hypotrachyna revoluta, Megaloblastenia flavidoatra, Opegrapha devia, Parmelia saxatilis, Parmelinopsis subfatiscens, Peltigera ulcerata, Pertusaria dactylina, Phyllopsora microdactyla, Siphula ramalinoides, Sphaerophorus patagonicus, Stereocaulon vesuvianum* and *Teloschistes xanthorioides.*

Floristic diversity

In this paper we record 251 lichen species in 96 genera from Little Barrier Island. This is very similar to the recorded lichen flora from nearby Great Barrier Island (247 species, 81 genera; Hayward et al. 1986). These are by far the largest of the offshore islands of northern New Zealand and therefore not surprisingly have the most diverse lichen floras. The next largest recorded lichen diversities on northern islands are on the Three Kings Islands (169 species, 81 genera; Galloway and Hayward 1987), Poor Knights Islands (144 species, 59 genera; Hayward and Wright 1991) and the Hen and Chicken Islands (156 species, 58 genera; Hayward and Hayward 1978, 1984). Of the two Barrier Island species lists, we consider that from Little Barrier Island to be the more complete and expect that a further 100, mostly microlichen, species probably occur on the larger Great Barrier Island, which also has the more diverse range of habitats. Combined Great and Little Barrier Islands have a lichen flora of 311 species in 104 genera. This is similar to comparable sized areas elsewhere in New Zealand (e.g. Waitakere Ranges, west Auckland — 372 species, 133 genera, Bartlett 1988; Nelson Lakes National Park — 260 species, 82 genera, Galloway and Simpson 1978).

Biogeographic elements in the lichen flora

Of the 251 species recorded here from Little Barrier Island, 30% are widespread cosmopolitan species of a temperate character (biogeographical terminology follows Galloway 1985). Species endemic to the New Zealand region account for 22% of the lichens recorded and 25% have an Australasian affinity. Pantropical taxa comprise 8%, paleotropical taxa comprise 3% and Western Pacific taxa comprise 3.5%. Austral species demonstrating an austral circumpolar distribution comprise 7% and bipolar species comprise 1.5%. In comparison with the total New Zealand lichen flora, that of Little Barrier reflects its northern geographic location, having a significantly larger percentage of pantropical and Western Pacific species and far fewer bipolar and endemic species.

Altitudinal zonation

In tandem with the vascular vegetation, the lichen flora also shows a rough zonation with increasing altitude. Some species occur from sea level all the way to the summit regions. A large group of lichens appear to be confined to lower altitudes and another group to higher altitudes. Table 1 presents data on the lowest recorded altitude of the more common members of the higher altitude lichen flora. Taxa restricted to the subalpine scrub and bluffs above 550 m on Little Barrier include the abundant *Siphula decumbens*, plus less common *Siphula ramalinoides, Sphaerophorus tener, Cladia sullivanii, Cladonia cornuta, C. crispata, C. squamosa, Nephroma plumbeum, Peltigera nana, P. ulcerata, Pertusaria dactylina, Phaeographis exaltata, Pseudocyphellaria rubella* and *Xanthoparmelia mougeotina*. Many of these are more common at lower altitudes in cooler more southern parts of New Zealand.

Of the common higher altitude forest lichens, the dominant *Sticta filix* is abundant above about 550 m with a lower limit for sparse colonisation of about 450 m. The common foliose *Pseudocyphellaria faveolata* has not been recorded below 450 m, *Sphaerophorus melanocarpus* not below 400 m, *Pseudocyphellaria multifida* not below 300 m and *Pseudocyphellaria glabra* not below 250 m. Of the common and distinctive higher altitude crustose lichens, *Coccotrema cucurbitula* has not been recorded below 450 m, *Miltidea ceroplasta* not below 350 m and *Catillaria kelica* not below 250 m. The main factor producing this altitudinal zonation on Little Barrier is not altitude above sea level per se, but probably a combination of increasing humidity and rainfall and slightly lower temperatures. The top of the island is clothed in cloud for considerable periods of time throughout the year.

LICHEN COMMUNITIES AND HABITATS

Marine and maritime

Most of Little Barrier Island is surrounded by mobile boulder beaches and relatively soft, rapidly eroding cliffs of laharic breccia that support virtually no lichen flora. A few andesite lava flows form intertidal reefs and maritime cliffs on the north and east coasts. Two black, rather nondescript lichens (*Verrucaria maura* and *Lichina confinis*) grow intertidally on these more stable reefs and a wide range of maritime lichens occur higher on these more solid cliffs. Stabilised boulders above storm wave height at the top of some of the boulder beaches (especially those fringing Te Titoki Point) also have a rich and diverse maritime lichen cover.

A total of 72 species have been recorded here from the maritime zone, within 30 m of the high tide mark and between 0 and 5 m above sea level. Lower on the shore and nearer high tide mark, the lichen flora is dominantly white and grey crustose types of the genera *Buellia, Lecidea* and *Pertusaria*. A little higher the rocks become covered in grey foliose forms mostly of the genera *Rimelia, Parmotrema* (4 spp.) and *Heterodermia* (4 spp.) and the yellow green foliose *Xanthoparmelia* (6 spp.). Higher in this zone, the rocks become more weathered, they are more stable, often partly shaded and may develop thin soil in crevices. Here the full diversity of maritime

Table 1. Lowest recorded altitude occurences (m above sea level) of some common macrolichens on Little Barrier Island. Comparisons with observations on Great Barrier (Hayward et al. 1986) are presented.

	Little Barrier			Great
	NE side	W side	S side	Barrier
Pseudocyphellaria glabra	300	270	250	?
Pseudocyphellaria multifida	350	300	300	?
Sphaerophorus patagonicus	480	300	—	450
Catillaria kelica	500	400	300	absent
Miltidea ceroplasta	—	—	350	480
Sphaerophorus melanocarpus	—	—	400	—
Pseudocyphellaria faveolata	—	—	450	—
Coccotrema cucurbitula	—	—	450	400
Sticta filix	450	550	450	absent
Sphaerophorus tener	—	—	660	—
Cladia sullivanii	—	560	580	350
Siphula decumbens	660	650	660	520

lichens is found with the prominent addition of the dark olive green foliose *Neofuscelia*, foliose *Pannaria elatior*, fruticose *Ramalina, Cladia aggregata, Cladonia* and *Stereocaulon ramulosum* and crustose *Lecanora campestris* and *Opegrapha diaphoriza.*

In several locations, rotting driftwood logs, cast high up above high tide mark by storms, are the only places where *Calicium* (all 3 species), *Cladonia pyxidata* and *Thysanothecium scutellatum* have been found on the island.

Coastal scrub

Coastal scrub occurs sporadically around the coast of Little Barrier between the top of the boulder beaches and the foot of the cliffs behind. The scrub usually has a wind-shorn canopy and is a mixture of taupata (*Coprosma repens*), *Melicytus novae-zelandiae*, karo, and kawakawa. A sparse but characteristic low diversity lichen flora is commonly encountered. It consists of a mix of yellow lichens of the genera *Xanthoria* and *Caloplaca*, grey *Physcia caesia* and several crustose species, especially *Opegrapha intertexta.* Lichens recorded only from this distinctive habitat include yellow-grey *Teloschistes chrysophthalmus*, orange crustose *Caloplaca inclinans*, red-fruited crustose *Lecidea laeta* and crustose *Trapeliopsis congregans.*

Coastal pohutukawa

Scattered pohutukawa forest occurs around the coast of Little Barrier — on some of the cliffs, on talus at the foot of some of these, and in the mouths of the larger stream valleys. The most notable area of almost pure pohutukawa coastal forest covers about 1.5 ha of the south-western part of Te Maraeroa. Forty-three lichen species have been recorded from this habitat — 36 species growing on the rough pohutukawa bark and 11 on the rocks beneath.

The lichens growing on pohutukawa bark are dominated by fruticose forms, especially species of *Hypotrachyna* (*H. osseoalba, H. immaculata*), *Parmelinopsis* (*P. jamesii, P. spumosa*), *Parmotrema* (*P. chinense, P. crinitum, P. tinctorum*), *Rimelia* (*R. cetrata, R. reticulata*) and *Pannaria elatior*. Also common is the fruticose old man's beard lichen (*Usnea inermis*). Taxa only found so far on pohutukawa bark on Little Barrier include the crustose *Lecanora symmicta, L. chlarotera, Megaloblastenia marginiflexa, Pertusaria sorodes* and foliose *Hypotrachyna immaculata*.

The rocks beneath the semi-open pohutukawa canopy are dominated by foliose *Parmotrema crinitum, Heterodermia japonica* and tufted *Ramalina celastri*.

Grassland and orchard

Much of Te Maraeroa, the flat land built up behind the Te Titoki boulder spit, is grazed mixed pasture with occasional large specimen trees of kanuka. These mature kanuka growing in the open have a rich lichen flora with 25 species recorded growing on their thick papery bark. Crustose species are rare but the abundant foliose types are often large healthy specimens dominated by *Pseudocyphellaria* (5 spp.), *Sticta* (3 spp.), *Leptogium* (4 spp.) and *Collema* (2 spp.). *Hypotrachyna revoluta, Lecidea cerinocarpa, Pseudocyphellaria granulata* and *Pseudocyphellaria haywardiorum* have been recorded so far only from this habitat on Little Barrier.

An aging orchard with a wide variety of fruit and ornamental trees grows on the flat around the ranger's house and the visitors' bunkhouse. Some of these introduced trees support a rich lichen flora, particularly characterised by old man's beard lichens (*Usnea* 3 spp.) and script lichens (*Phaeographis australiensis, Opegrapha intertexta*). Four species not recorded elsewhere on the island on the indigenous vegetation are *Arthonia tumidula* (on an old walnut tree), *Melaspilea subeffigurans, Punctelia borreri* and *Teloschistes xanthorioides* (on an old fig tree).

Mature kanuka and kanuka-mixed forest

Approximately one-third of Little Barrier Island is clothed in kanuka and kanuka-mixed forest in varying stages of transition to kauri and broadleaf forest, following clearing by the prehistoric Maori and by kauri logging and firewood operations in European times. This type of forest is all low altitude, below about 300 m above sea level and concentrated on the remnants of the old volcanic ring plain, especially around the south and west sides of the island. On the valley sides, the forest is quite damp which has hastened regeneration of tree species in addition to kanuka, resulting in a canopy that is often quite dense with a shade tolerating lichen flora (26 spp.). On the ridge crests however, the forest is often still primarily mature kanuka with a more open canopy allowing the growth of a luxuriant lichen flora (73 spp.) both on the flaking kanuka bark (53 spp.) and also on the forest floor beneath (22 spp.). By far the most abundant lichen type colonising kanuka bark is the foliose group, dominated by 9 species of *Pseudocyphellaria* (especially *P. carpoloma, P. montagnei* and *P. coriacea*), *Sticta latifrons*, 5 species of *Psoroma*, all 3 species of *Coccocarpia*, 3 species of *Heterodermia* and 4 species of *Pannaria*. Among the sporadic crustose lichens growing on kanuka bark, the most common are 3 species of script lichen *Opegrapha* and *Thelotrema lepadinum*. Beneath the kanuka forest, the ground

dwelling lichens are dominated by reindeer lichen *Cladina confusa, Cladia aggregata, Stereocaulon ramulosum, Cladonia capitellata, C. chlorophaea, C. ochrochlora* and 6 other species of *Cladonia* and 3 species of *Pannaria*. Also locally common on clay banks are *Baeomyces arcuatus* and *B. heteromorphus* and in damper situations amongst moss is *Peltigera dolichorhiza*.

Kauri forest

On Little Barrier, kauri forest, sometimes with co-dominant hard beech or miro (*Prumnopitys ferruginea*) occurs as a mosaic on ridges and upper valley sides 100-500 m above sea level. Forty-six species of lichen have been recorded from this forest type so far. The visibly most dominant species on bark are the foliose *Pseudocyphellaria glabra, P. multifida, Psoroma* (6 spp.), *Sticta latifrons, Heterodermia* (3 spp.) and *Menegazzia* (4 spp.). Several crustose forms are common on bark, especially *Megalospora gompholoma, M. knightii* and *Megalaria grossa*. No lichens were found growing on the very rough bark of mature hard beech trunks, although the smoother bark of the younger trees and limbs sometimes supported the script lichens *Graphis librata* and *Opegrapha intertexta*.

The distinctive *Metus conglomeratus*, with black apothecia on fissured green podetia, occurs quite commonly on moss-covered clay beneath the kauri mixed forest canopy.

Mixed forest (250-500 m above sea level)

Between 250 m and 500 m above sea level on Little Barrier, the forest cover consists of a kauri mosaic interspersed with a mixed broad-leaved forest dominated by tawaroa and northern rata (*Metrosideros robusta*) with common miro, Hall's totara (*Podocarpus hallii*) and pukatea (*Laurelia novae-zelandiae*). This mixed forest fills most of the valleys but also extends up onto the ridge crests in many places.

A rich and diverse epiphytic lichen flora occurs in this mixed, tawaroa-dominated forest. *Pseudocyphellaria* (7 spp.) are the dominant foliose lichens, especially *P. multifida* and *P. glabra*. The most abundant crustose lichens are *Megalospora* (4 spp.), the script lichens *Phaeographis* and the bright yellow-fruited *Catillaria kelica*. The dimly-lit forest floor, especially in the valleys, are often festooned with prolific grey foliose *Pseudocyphellaria dissimilis*.

Mixed forest (500-700 m above sea level)

On reaching about 500 m above sea level while ascending Little Barrier, the forest becomes dominated by tawhero (*Weinmannia sylvicola*) with common associated tawaroa. Still higher on the ridges, above about 600 m, this forest type grades into a mixture of tawari (*Ixerba brexioides*), southern rata and tawheowheo (*Quintinia acutifolia*). The canopy is quite low (3-5 m) but beneath it high humidity conditions are constantly present with the trees draped in mosses, liverworts, filmy ferns and lichens.

Foliose and fruticose lichens dominate, with the stalked, lettuce green foliose *Sticta filix* usually the most abundant, followed by foliose *Pseudocyphellaria multifida, P. faveolata, and P. glabra*, and fruticose *Sphaerophorus melanocarpus* and *Cladia aggregata. Sphaerophorus tener* and *Siphula decumbens* are abundant above about 650 m.

Subalpine scrub and bluffs

On the most exposed peaks near the top of Little Barrier (e.g. Hauturu, Bald Rock, The Thumb and a ridge crest 800 m north-west of Hauturu), the high altitude forest is kept to a 1-2 m high scrub by the prevailing strong winds. The scrub is varied and diverse in composition (Hamilton and Atkinson 1961), as is the lichen flora with 49 species so far recorded. No lichens dominate, but common epiphytic species include *Siphula decumbens, Sticta filix, S. latifrons, Pseudocyphellaria coronata, P. faveolata, P. glabra, P. lividofusca, Sphaerophorus tener* and the crustose *Phaeographis exaltata* and orange-fruited *Miltidea ceroplasta. Cladina confusa, Cladonia* (7 spp.) and *Peltigera* (2 spp.) are the most abundant epigean lichens.

On some of the steepest rocky bluffs at the top of the island (e.g. Bald Rock), the elements have been too severe for most higher plants to colonise, but lichens such as *Hypogymnia subphysodes, Stereocaulon ramulosum S. vesuvianum, Rimelia* (2 spp.) and *Parmotrema* (3 spp.) flourish on moist faces. Fruticose lichens, such as *Cladia aggregata, C. retipora, C. sullivanii, Cladina confusa, Cladonia capitellata* and *C. floerkeana* often grow on small patches of soil that have accumulated in crevices in the rock.

Acknowledgements. We would like to thank members of the Auckland University Field Club and Offshore Islands Research Group for assistance in the field during our two visits to Little Barrier Island. For the identification of difficult specimens we are grateful to David Galloway (The Natural History Museum, London, — *Pseudocyphellaria, Sticta*), Doug Verdon (Australian National University, Canberra, — *Collema, Leptogium*), Thorsten Lumbsch (Universitet Essen — saxicolous crustose lichens) and the late Mason Hale (Smithsonian Institution, Washington — Parmeliaceae). Barbara Polly (National Museum, Wellington) kindly provided the record of *Lecanactis redingeri.*

REFERENCES

BARTLETT, J. K.
1988 Lichens of the Waitakere Ranges. *Auckland Bot. Soc. Bull.* 17:1-29.

GALLOWAY, D. J.
1985 *Flora of New Zealand: Lichens.* Wellington, N.Z. Govt. Printer. 662p.

GALLOWAY, D. J., and B. W. HAYWARD
1987 Lichens from the Three Kings Islands, northern New Zealand. *Rec. Auckland Inst. Mus.* 24:197-213.

GALLOWAY, D. J., and M. J. A. SIMPSON
1978 Lichens of Nelson Lakes National Park, New Zealand. *N.Z.J. Bot.* 16:507-527.

HAMILTON, W. M., and I. A. E. ATKINSON
1961 Vegetation. *In* Hamilton, W.M. (Comp.) *Little Barrier Island (Hauturu). N.Z. Dept. Sci. Indust. Res. Bull.* 137:87-121.

HAYWARD, B. W.
1982 Prehistoric archaeological sites on Little Barrier Island, New Zealand. *Tane* 28:67-78.

HAYWARD, B. W., and G. C. HAYWARD
1984 Lichens of the Chickens Islands, northern New Zealand. *Tane* 30:43-51.

HAYWARD, B. W., G. C. HAYWARD and D. J. GALLOWAY
1986 Lichens of Great Barrier Island and adjacent islands, northern New Zealand. *J.R. Soc. N.Z.* 16(2):121-137.

HAYWARD, G. C., and B. W. HAYWARD
1978 Lichens of Hen Island, northern New Zealand. *Tane* 24:119-130.

HAYWARD B. W., and A. E. WRIGHT
1991 Lichens from the Poor Knights Islands, northern New Zealand — additions and an updated species list. *Tane* 33:34-48.

KEAR, D.
1961 Physiography. *In* Hamilton, W.M. (Comp.) *Little Barrier Island* (*Hauturu*). *N.Z. Dept. Sci. Indust. Res. Bull.* 137:33-42.

B.W. HAYWARD and A.E. WRIGHT, Auckland Institute and Museum, Private Bag 92018, Auckland. G.C. HAYWARD, 19 Debron Avenue, Remuera, Auckland.